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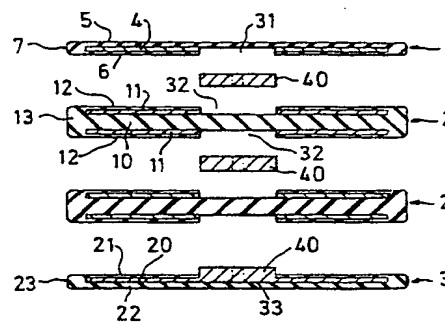
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54 Bridge bearing.

57 A bridge bearing comprises a plurality of elements (1, 2, 3) each comprising at least one metal plate (4, 11, 20) at least one of the elements (2) having a layer of rubber (10) disposed between two of the metal plates (11), each metal plate (4, 11, 20) having a single recess (31, 32 or 33) of a shape which is acircular in plan view formed therein, the elements being arranged in a stack, each pair of adjacent metal plates of adjacent elements being restrained from relative rotation about a vertical axis by a key (40) located in the recesses of those plates, the layer(s) of rubber being for absorbing relative rotational movement about a horizontal axis between the top and bottom of the stack. The key or each of the keys and the recesses are preferably cruciform in the shape. If any key were omitted during assembly of the bearing the bearing would fail immediately upon attempted use. The bearing could not function satisfactorily for a short time before falling.



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Bridge Bearing

FIELD OF THE INVENTION

The present invention relates to bridge bearings and more particularly to bridge bearings made of laminated rubber and metal.

BACKGROUND OF THE INVENTION

The purpose of a bridge bearing is to compensate for relative movement between a bridge beam and a support, such as a pier or abutment, for the bridge beam. This movement may be caused, for example, by expansion and contraction resulting from temperature changes or settlement of the support or by heavy vehicles travelling over the bridge. If means are not provided to compensate for such movement, cracking and ultimate failure of the bridge beam or the support may result.

A known bridge bearing comprises an upper element, at least one intermediate element and a lower element, the elements being bonded together. The upper and lower elements each consist of a metal plate and a layer of rubber on one face of the plate. The or each intermediate element consists of a layer of rubber sandwiched between two metal plates. The elements are stacked in alignment with the metal plates in contact one with another and with the adjacent metal plates of contiguous elements mechanically keyed together. The mechanical keying may be provided by keying members constituted by rings and discs which are located in holes in adjacent metal plates and between adjacent layers of rubber. A plurality of the keying members are provided between each two adjacent elements to key those elements together.

The disadvantages of the known bridge bearings are:

- (1) The mechanical keying between each pair of adjacent metal plates has to be provided at a plurality of locations to prevent relative horizontal rotation between the contacting surfaces of adjacent elements.

(2) It can happen that during assembly of the bridge bearing one or more of the keying members may be omitted, the assembled bearing not appearing defective, but being liable to fail in situ after a period of use.

(3) The surfaces of the metal plates not covered by a layer of rubber are liable to rust or other corrosion. Such corrosion may effect the bonding between the elements prior to installation of the bridge bearing or effect the ability of the bearing to effect the ability of the bearing to absorb movement after installation of the bearing.

The uppermost and lowermost metal plates each have to be fixed relative to the beam and the support respectively. This is usually achieved, where the beam and the support are of concrete, by casting bolts or shaped bars into the beam and the support for engagement with the respective metal plates.

BRIEF DESCRIPTION OF THE INVENTION

It is an object of the invention to overcome or mitigate the disadvantages set out above.

In accordance with the present invention, there is provided a bridge bearing comprising a plurality of elements each comprising at least one metal plate, at least one of the elements having a layer of rubber disposed between two of the metal plates, each metal plate having a single recess of a shape which is acircular in plan view formed therein, the elements being arranged in a stack, each pair of adjacent metal plates of adjacent elements being restrained from relative rotation about a vertical axis by a key located in the recesses of those plates, the layer(s) of rubber being for absorbing relative rotational movement about a horizontal axis between the top and bottom of the stack.

In some embodiments of the invention, the layer(s) of rubber may also serve for absorbing relative horizontal translational movement between the top and bottom of the stack.

The or each key must be a circular in plan view and is preferably of like shape in plan view to the recesses in which it is located.

Preferably the or each recess comprises, in plan view, or least two arms at an angle to each other and the or each key comprises two arms at an angle to each other.

Preferably to provide maximum restraint against relative rotation of adjacent elements, each recess is cruciform and the or each key is cruciform in plan view.

In order to provide for frictional engagement between the bottom of the bearing and a concrete bridge support, preferably the lowermost element comprises a layer of rubber on the lower surface of its metal plate. Similarly, in order to provide for frictional engagement between the top of the bearing and a concrete bridge beam, preferably the uppermost element comprises a layer of rubber on the upper surface of the metal plate. Such layers of rubber allow the use of bolts or other locating members cast into the bridge support and the bridge beam to be dispensed with, the bridge bearing being held in position between the support and the beam solely by friction.

Preferably each element comprises a layer of rubber on each of the upper and lower surfaces of the metal plate or plates, the layers of rubber being integral with each other at the periphery of the plate or plates to protect the plate or plates against corrosion.

The bridge bearing may comprise a first element including a layer of low friction polymeric material (such as polytetrafluoroethylene) and a second element including a smooth metal surface, the layer of low friction polymeric material bearing on the

smooth metal surface to allow relative horizontal translational sliding movement between the first and second elements (and thus between the top and bottom of the stack).

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is further described below by way of example with reference to the accompanying drawings, in which:

Figure 1 is a sectional exploded view of a first bridge bearing according to the invention;

Figure 2 is a side view, partly in section, of the first bridge bearing when assembled;

Figure 3 is a plan view of the first bridge bearing;

Figure 4 is a plan view of an intermediate element of the first bridge bearing;

Figure 5 is a plan view of a key of the first bridge bearing;

Figure 6 is a side view, partly in section, of an intermediate element of the first bridge bearing;

Figure 7 is a sectional exploded view of a second bridge bearing according to the invention;

Figure 8 is a side view, partly in section, of the second bridge bearing when assembled;

Figure 9 is a plan view of the second bridge bearing;

Figure 10 is a sectional exploded view of a third bridge bearing according to the invention; and

Figure 11 is a plan view of the third bridge bearing (on a

smaller scale than Figure 10).

Throughout the drawings, like reference numerals indicate like parts.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, the first bridge bearing comprises an upper element 1, a plurality of intermediate elements 2, and a lower element 3.

The upper element 1 comprises a steel plate 4 having a layer 5 of rubber on its upper surface a thin layer 6 of rubber on its lower surface. The layers 5 and 6 are integrally formed with a rubber strip portion 7 surrounding the entire periphery of the plate 4.

Each of the intermediate elements 2 comprises a thick layer 10 of rubber sandwiched between two steel plates 11 and a thin layer 12 of rubber on the sides of the steel plates remote from the thick layer 10. The layers 10 and 12 are integrally formed with a rubber strip portion 13 surrounding the entire periphery of each of the plates 11.

The lower element 3 is substantially identical to the upper element 1 (but in the assembled bearing is inverted relative to the element 1) and comprises a steel plate 20 having a thin layer 21 of rubber on its lower surface and a layer 22 of rubber on its lower surface, the layers 21 and 22 being integrally formed with a rubber strip portion 23 surrounding the entire periphery of the plate 20.

The upper element 1 is provided with a keyway 31 formed within the entire thickness of the plate 4 and the rubber layer 6 but not extending into the rubber layer 5. Similarly the lower element 3 is provided with a keyway 33 formed within the entire thickness of the plate 20 and the rubber layer 21 but not extending

into the rubber layer 22.

Each of the intermediate elements 2 is provided with two keyways 32, one keyway being formed in the upper rubber layer 12 and the upper plate 11 and the other being formed in the lower rubber layer 12 and the lower plate 11 and neither keyway extending into the rubber layer 10.

Figure 4 is a plan view of either one of the intermediate elements 2. A plan view of the lower element 3, an inverted plan view of the upper element 1 or an inverted plan view of either intermediate element 2 would be identical to Figure 4. As shown in Figure 4, each keyway 30, 32 or 33 is, in plan view, cruciform and centrally disposed relative to the element in which it is provided.

The bearing further comprises steel keys 40, as shown in Figure 5, which are, in plan view, cruciform in shape and of the same dimensions as the keyways 31, 32 and 33. The thickness of each key 40 is equal to twice the depth of one of the keyways.

To assemble the bearing, the elements are stacked one on top of another as shown in Figure 2 with a key 40 being located in the adjacent keyways of each pair of adjacent elements. I.e. one key 40 is located in the keyway of the lower element 3 and the lower keyway 32 of the lower intermediate element 2, and the lower keyway 32 of the upper intermediate 2 and one key is located in the upper keyway 32 of the upper intermediate element 2 and the keyway 31 of the upper element 1.

If any key 40 is omitted during assembly of the bearing, it is difficult to assemble the bearing and the bearing will fail immediately upon attempted use. Thus there is no possibility of the bearing functioning satisfactorily in use for a short time and then failing.

For ease of transport of the assembled bearing prior to use, it may be convenient to attach the adjacent elements together by means of adhesive applied to the rubber layers 6, 12 and 21.

In use of the bearing, the bearing is positioned on a concrete pier or abutment 100 of a bridge and a concrete bridge beam 101 positioned on the bearing. Thus the lower element 3 bears on (and frictionally engages) the pier or abutment and the bridge beam bears on (and frictionally engages) the upper element 1. The bridge beam may tend to undergo horizontal translational movement and/or horizontal rotational movement (i.e. rotational movement about a horizontal axis). Such movement is absorbed by deformation of the rubber layers of the bridge bearing, especially the thick rubber layers 10 of the intermediate elements 2. Sliding movement (whether translational movement or horizontal rotational movement) of the elements 1, 2 and 3 relative to each other is prevented by the keys 40.

Also the metal plates 4, 11 and 20 and the keys 40 are entirely encased in rubber and thus are protected against corrosion.

Referring to Figure 7 and 8, the second bridge bearing comprises an upper element 1, an intermediate element 2 and keys 40, these components being identical to the like numbered components of the first bridge bearing. The second bearing further comprises a slide element 50 and a lower element 60.

The slide element 50 comprises a steel block 51 and a stainless steel sheet 52 secured, e.g. by adhesive, to the lower face of the block. In the upper face of the block 51 there is formed a keyway 53 of the same shape and dimensions as the keyways 31 and 32 in the upper and intermediate elements 1 and 2.

The lower element 60 comprises a steel plate 61 having a layer of rubber 62 on its lower surface and a ptfe (polytetrafluoro-

ethylene) layer 68 on its upper surface. The rubber layer 62 is integrally formed with a thickened edge portion 64 extending around the entire periphery encased between the rubber layer 62, the rubber edge portion 64 and the ptfe layer 63. The plate 61 is thus protected from corrosion. The ptfe layer 63 is bonded or screw-fixed to the metal plate 61.

To assemble the bearing the elements are stacked one on top of another as shown in Figure 8 with a key 40 being located in the adjacent keyways of each pair of adjacent elements. I.e. one key 40 is located in the keyway 53 of the slide element 50 and the lower keyway 32 of the intermediate element 2 and another key 40 is located in the upper keyway 32 of the intermediate element and the keyway 31 of the upper element 1.

As with the first bearing, if either key 40 is omitted during assembly of the second bearing, the bearing will fall immediately upon attempted use and thus there is no possibility of the bearing functioning satisfactorily in use for a short time and then failing.

For ease of transport of the assembled bearing prior to use, it may be convenient to attach the elements 1,2 and 50 together by means of adhesive applied to the rubber layers 6 and 12 and to the upper surface of the block 51.

In use of the bearing, the lower element 60 bears on (and frictionally engages) a concrete pier or abutment 100 of a bridge and a concrete bridge beam 101 bears on (and frictionally engages) the upper element 1. The bridge beam may tend to undergo horizontal translational movement and/or horizontal rotational movement and/or vertical rotational movement. Horizontal movement, whether translational or rotational, is absorbed by the element 50 sliding upon the element 60. Vertical rotational movement is absorbed by deformation of the rubber layers of the bridge

bearing, especially the thick rubber layer 10 of the intermediate element 2. Sliding movement (whether translational movement or horizontal rotational movement) to the elements 1, 2 and 50 relative to each other is prevented by the keys 40.

For some uses, the intermediate element 2 (and hence one key 40) may be omitted in assembling the bearing.

Referring to Figure 10, the third bridge bearing comprises upper and lower elements 1 and 3 and the keys 40, these components being identical to the like-numbered components of the first bridge bearing. The third bridge bearing also comprises a slide element 70, a first intermediate element 80 and a second intermediate element 90.

The element 70 is identical to the element 50 (described above with reference to the second bridge-bearing) except that the metal block 51 is provided with threaded lateral bores which receive bolts 71 by means of which steel strips 72 are attached to two opposite edges of the block 51.

The element 80 comprises a thick layer 81 of rubber sandwiched between an upper steel plate 82 and a lower steel plate 83. A layer 84 of ptfe is provided on the surface of the plate 82 and a thin layer 85 of rubber is provided on the lower surface of the plate 83.

The rubber layers 81 and 85 are integrally formed with a strip portion 86 which extends up to the ptfe layer 84. Within the rubber layer 85 and the metal plate 83 is formed a keyway of the same shape and dimensions as the keyways previously described.

The element 90 comprises a thick metal plate 91 having keyways 92 formed in its upper and lower faces, the keyways being of the same shape and dimensions as the keyways previously described. Also the plate 91 is provided with threaded lateral bores which

receive bolts 93 by means of which steel strips 94 are attached to two opposite edges of the plate 91. A ptfe strip 95 is attached by bonding to each of the steel strips 94.

In the assembled bearing, the elements are stacked one on top of another as shown in Figure 10 with a key 40 located in the keyway of the lower element 3 and the lower keyway of the element 90, a key 40 located in the upper keyway of the element 90 and the keyway of the element 80 and a key 40 located in the keyway of the element 70 and the keyway of the element 1.

The steel plate 52 rests on the ptfe layer (84) and the strips 72 bear on the ptfe strip 95 attached to the strips 94.

In use of the bearing, the lower element 3 bears on (and frictionally engages) a pier or abutment of a concrete bridge and a concrete bridge beam bears on (and frictionally engages) the upper element 1. The bridge beam may tend to undergo horizontal translational movement in the directions indicated by the arrows A in Figure 11 and such movement is absorbed by sliding movement of element 70 on the element 80 and sliding movement of the strips 72 along the strips 94. The bridge beam may also tend to undergo vertical rotational movement about an axis normal to the strips 72 and 94. Such movement is absorbed by deformation of the rubber layers especially the thick rubber layer 81.

The bridge bearing resists horizontal movement in the directions normal to the arrows A because of the engagement between the strips 72 and the strips 94 and the provision of the keys between the elements 1 and 70 and between the elements 90 and 3.

In use of each of the bridge bearings shown in the drawings, the rubber layers are always under compression over their entire plan area even under the maximum envisaged vertical rotation of the elements which in practice would be rotation about an axis extending longitudinally at the bridge beam.

CLAIMS

1. A bridge bearing comprising a plurality of elements each comprising at least one metal plate, at least one of the elements having a layer of rubber disposed between two of the metal plates, each metal plate having a single recess of a shape which is acircular in plan view formed therein, the elements being arranged in a stack, each pair of adjacent metal plates of adjacent elements being restrained from relative rotation about a vertical axis by a key located in the recesses of those plates, the layer(s) of rubber being capable of absorbing relative rotational movement about a horizontal axis between the top and bottom of the stack.
2. A bridge bearing according to claim 1, wherein the layer(s) of rubber also serve for absorbing relative horizontal translational movement between the top and bottom of the stack.
3. A bridge bearing according to claim 1 or 2, wherein the or each key is of like shape in plan view to the recesses in which it is located.
4. A bridge bearing according to any preceding claim, wherein the or each recess comprises, in plan view, at least two arms at an angle to each other and the or each key comprises at least two arms at an angle to each other.
5. A bridge bearing according to claim 4, wherein each recess is cruciform in plan view and the or each key is cruciform in plan view.

6. A bridge bearing according to any preceding claim, wherein the lowermost element comprises a layer of rubber on the lower surface of its metal plate.

7. A bridge bearing according to any preceding claim, wherein the uppermost element comprises a layer of rubber on the upper surface of the metal plate.

8. A bridge bearing according to any preceding claim, wherein each element comprises a layer of rubber on each of the upper and lower surfaces of the metal plate or plates, the layers of rubber being integral with each other at the periphery of the plate or plates to protect the plate or plates against corrosion.

9. A bridge bearing according to any preceding claim, including a first element including a layer of low friction polymeric material and a second element including a smooth metal surface, the layer of low friction polymeric material bearing on the smooth metal surface to allow relative horizontal translational sliding movement between the first and second elements (and thus between the top and bottom of the stack).

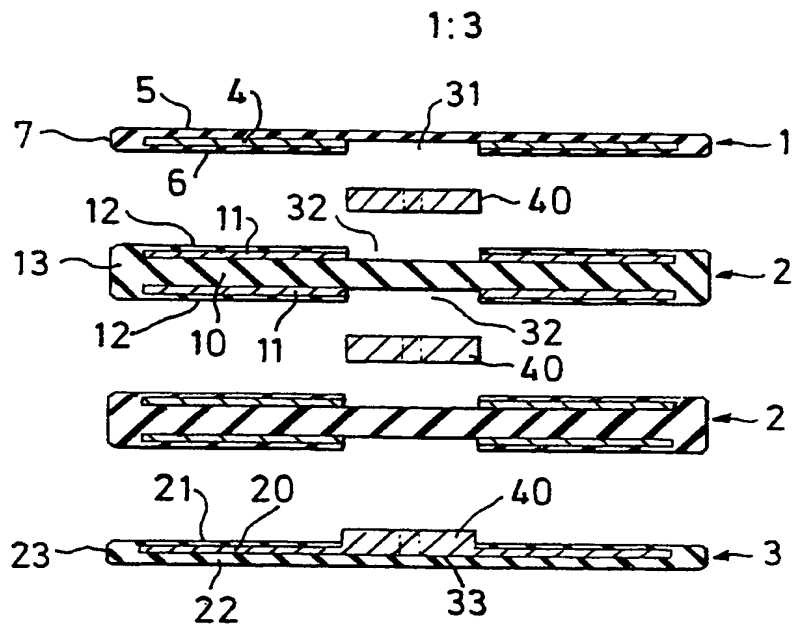


FIG. 1.

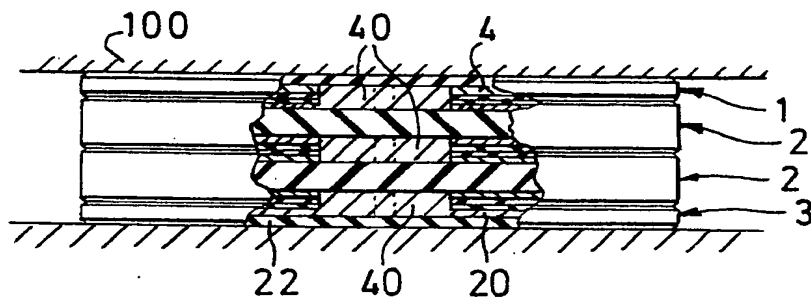


FIG. 2.

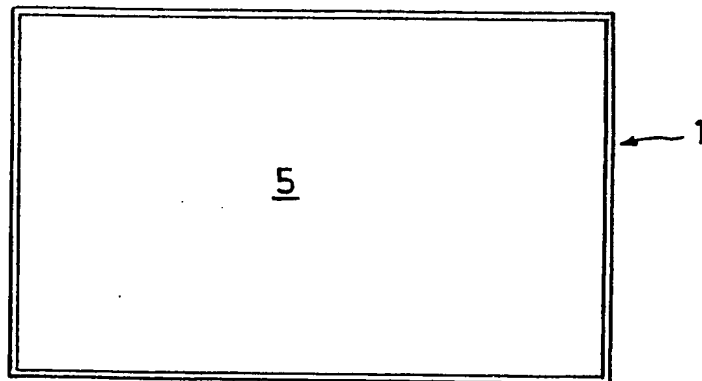


FIG. 3.

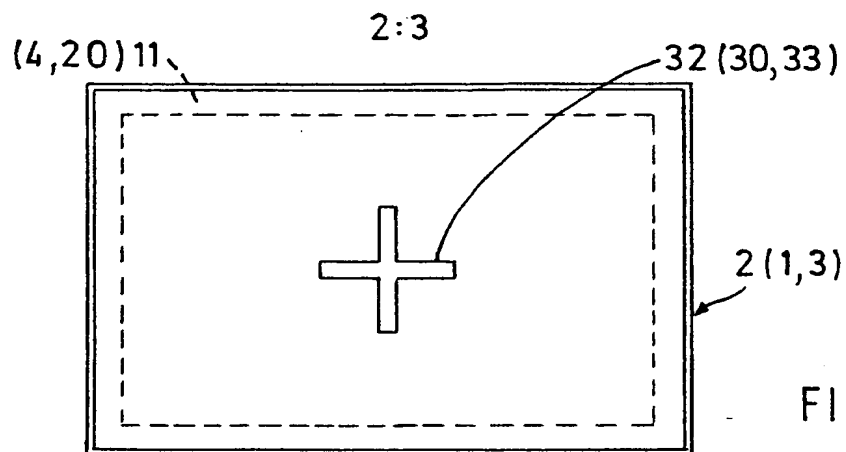


FIG. 4.

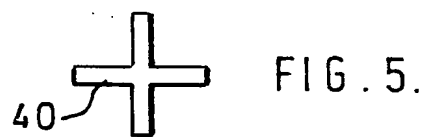


FIG. 5.

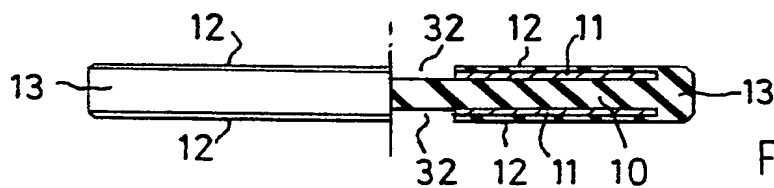


FIG. 6.

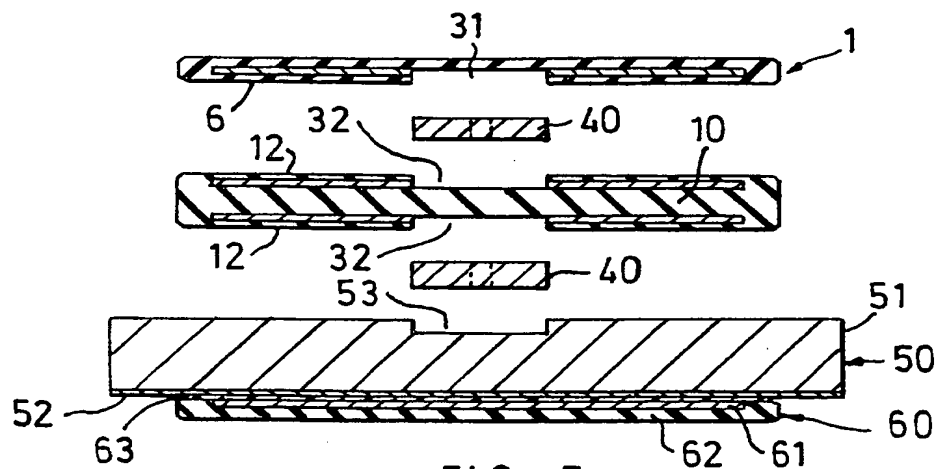


FIG. 7.

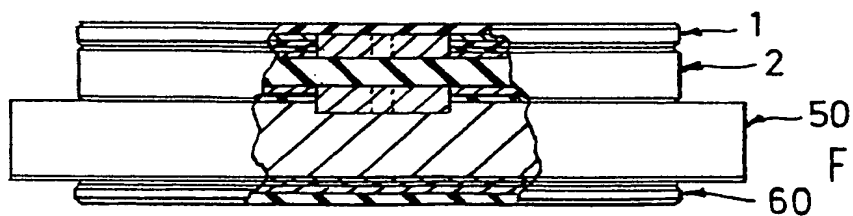
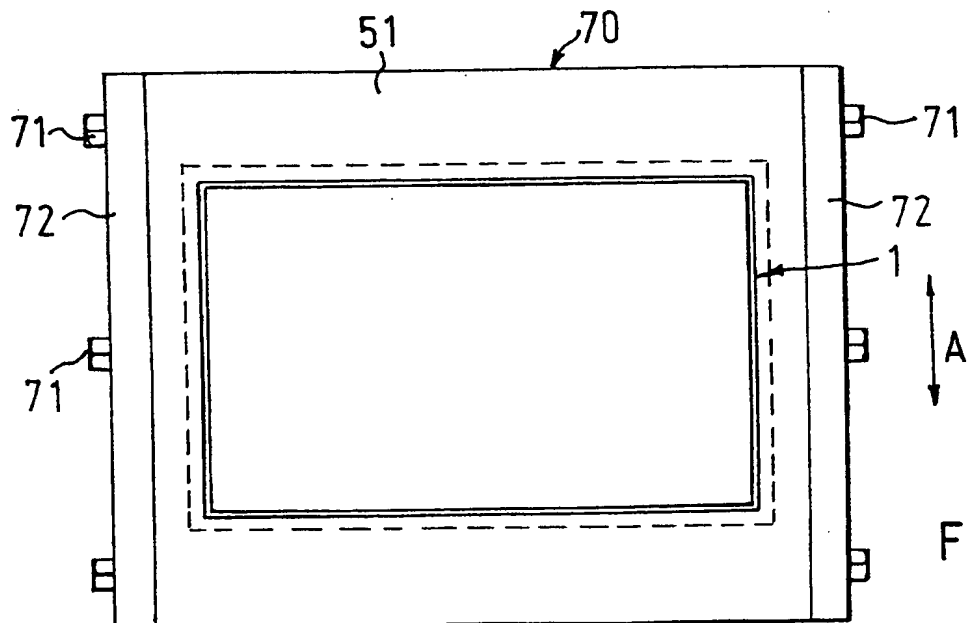
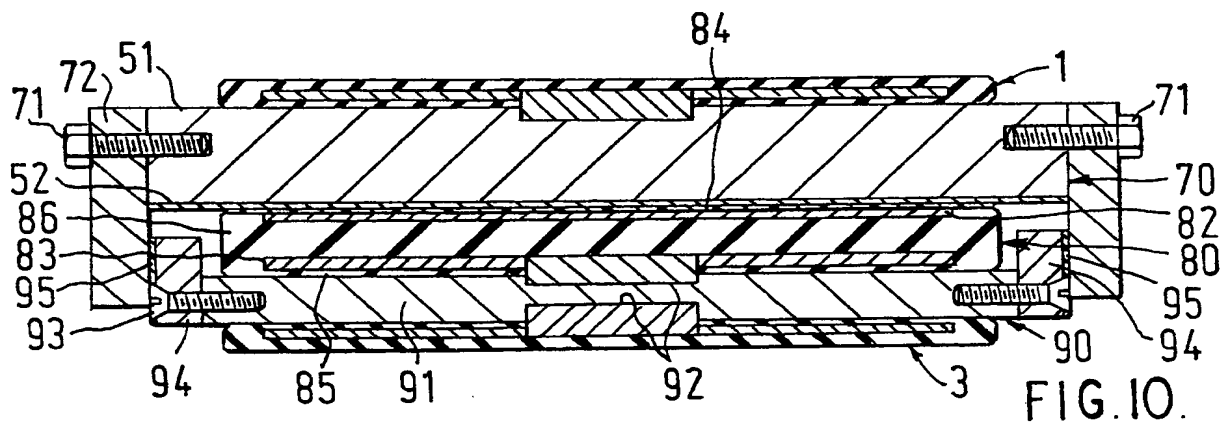
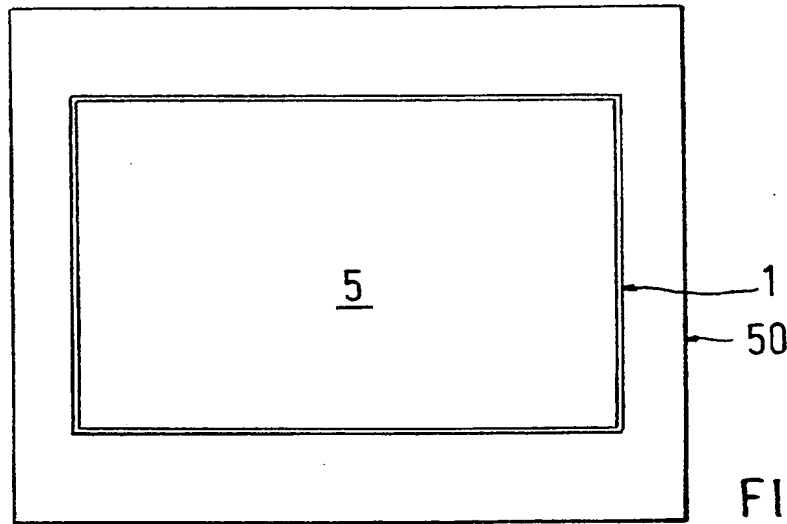


FIG. 8.





European Patent
Office

EUROPEAN SEARCH REPORT

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Application number

EP 80 30 2352.2

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int. Cl.)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	<u>DE - A - 2 024 386</u> (SILENT CHANNEL PRODUCTS LTD.) * whole document *		E 01 D 19/04
A	<u>DE - B - 1 299 015</u> (A. RUBBER CO. LTD.) * whole document *		
A	<u>DE - U - 1 795 263</u> (SOCIETA APPLICAZIONI GOMMA ANTIVIBRANTI SAGA) * whole document *		TECHNICAL FIELDS SEARCHED (Int. Cl.)
A	<u>FR - E - 84 050</u> (SOCIETA APPLICAZIONI GOMMA ANTIVIBRANTI SAGA) * whole document *		E 01 D 19/00
A	<u>FR - A - 1 391 620</u> (SOCIETE APPLICAZIONI GOMMA ANTIVIBRANTI SAGA) * whole document *		
A	<u>CH - A - 444 582</u> (F.I.P.-FORNITURE INDUSTRIALI PADOVA-SOCIETA IN NOME COLLETTIVO DI COLBACHINI & CHIAROTTO) * fig. 1 to 3 *		CATEGORY OF CITED DOCUMENTS
			X: particularly relevant A: technological background O: non-written disclosure P: intermediate document T: theory or principle underlying the invention E: conflicting application D: document cited in the application L: citation for other reasons
			&: member of the same patent family. corresponding document
<input checked="" type="checkbox"/> The present search report has been drawn up for all claims			
Place of search	Date of completion of the search	Examiner	
Berlin	14-10-1980	PAETZEL	